1961

Eugenics Quarterly

Vol. 8 March, 1961 No. 1

THE RELATION OF POPULATION FERTILITY LEVELS TO ETHNIC GROUP BACKGROUNDS
Jack B. Bresler

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THE HUMAN BIOLOGY OF ACADEMIC POTENTIAL: A PROPOSED INVESTIGATION[1]

JACK B. BRESLER, FRANCES E. DUNN, HELEN L. URQUHART AND ELMER R. SMITH

Brown University
Rhode Island

IT IS ALWAYS fruitful to look for ways with which to understand human intelligence and the influences which have shaped it. Insights into the problems of intelligence are not exclusive property of any one discipline, for knowledge on this subject has come from as diverse fields as philosophy and chemistry, psychology and literature.

Through a series of fortunate developments and an extraordinary degree of cooperation from many individuals, a group of us at Brown University will be able to explore some of the cultural and genetic conditions underlying the academic potential of entering college students. In view of this multidisciplined approach which will be taken, we have decided to call the over-all project "The Human Biology of Academic Potential."

[1] This investigation was supported by a research grant, B-2356, from the National Institute of Neurological Diseases and Blindness, Public Health Service.

DEVELOPMENT OF THE PROJECT

During the summer of 1958, while working on a study of ABO-Rh interaction, one of us (J.B.B.) had the occasion to examine the blood typings of the Providence Chapter of the American Red Cross. By chance a file of almost 1,000 Brown-Pembroke student typings was discovered. These students (classes 1952–57) had kindly donated blood during the Korean conflict.

It came to mind that these blood types could be related with the extensive battery of intelligence, achievement, aptitude, and interest tests regularly given to Brown-Pembroke freshmen. Twenty-five years ago, the idea of relating behavior characteristics to blood types, or of even postulating that behavioral characteristics had a considerable genetic basis, would have been rejected as rash assumptions. However, during the past 10 or 15 years studies have shown that human blood types are not neutral, as once was supposed, but are associated with various diseases (McConnell 1956).

A large body of literature has been built up dealing with the selective advantages and disadvantages of human blood types.

Similarly, there are on record a substantial number of investigations relating intelligence and behavior to a genetic basis. This area has been summarized by Fuller and Thompson (1960).

The staffs of the Office of Educational Measurement and the Department of Education of Brown University approved of the plan and provided the test scores of all the students—now alumni—who donated blood. Various members of these staffs are now actively participating in the project. In time, as additional information on these alumni accumulates, other investigators from other disciplines such as psychology and sociology may join those conducting these studies.

At present, we have the alumni scores (taken as freshmen) on the tests shown in Table 1.

There is also available the 4-year cumulative academic average for each person.

We were aware that any association between blood types and test scores would have to apply generally to all ethnic groups in order to be accepted as a valid association. This criticism of ABO association studies is discussed elsewhere (Clarke and Sheppard 1956).

The next step therefore was to obtain detailed ethnic group information for each alumnus. This was lacking in any records available to us. Accordingly, with the approval and cooperation of the Brown and Pembroke Alumni offices, 920 alumni were solicited by mail for information on their background. We asked for the place of birth and racial designation of their parents and grand-

TABLE 1
NAMES AND SOURCES OF TESTS TAKEN BY BROWN-PEMBROKE FRESHMEN

NAME	SOURCE
1. Scholastic Aptitude Test-Verbal Section (CEEB)	Educational Testing Service Princeton, New Jersey
2. Scholastic Aptitude Test-Math Section (CEEB)	Same
3. Brown University Psychological Examination-Form MBE	Office of Educational Measurement, Brown University (Not commercially available)
4. Iowa English Training Test	Bureau of Educational Research and Service, State University of Iowa, Iowa City, Iowa
5. Cooperative General Achievement Test—Part II Cooperative Natural Sciences	Cooperative Test Division Educational Testing Service Princeton, New Jersey
6. Cooperative General Achievement Test—Part III Cooperative Mathematics	Same
7. OII Personal-Social Occupational Interest Inventory-Advanced Form, Original Edition	California Test Bureau Los Angeles, California
8. OII Natural	Same
9. OII Mechanical	Same
10. OII Business	Same
11. OII Arts	Same
12. OII Sciences	Same
13. OII Verbal	Same
14. OII Manipulative	Same
15. OII Computational	Same
16. OII Level	Same

parents. We also asked for the religious affiliation of their parents and grandparents at the time these individuals were children. Accordingly we have obtained ethnic group data on at least seven individuals in each family group. Each of these family groups bridges three generations and covers very nearly 100 years.

The response of the alumni, shown in Table 2, was gratifying.

TABLE 2
ETHNIC QUESTIONNAIRES MAILED AND RETURNED

	Questionnaires Mailed	Questionnaires Returned	% Returned
Brown (men)	780	668	85.6
Pembroke (women)	140	136	97.1
Total	920	804	87.4

By agreement with the alumni, names or other identifying features will not be presented in the literature. The emphasis throughout this study will be upon population characteristics.

Through the courtesy of other administrative officers, we are able to examine the entrance papers and records on academic achievements of each of the alumni. A number of items, such as mother's year of birth, father's year of birth, and number of siblings, were also accumulated for each individual.

Thus, from many sources we were able to gather a substantial body of data on a large sample of Brown-Pembroke students.

THE HYPOTHESES

The data will be analyzed in the light of a number of hypotheses. These will be provided with the issuance of each report. However, the dominant and always pervading hypothesis will be that there exists a difference between the academic potential of the "hybrid" ethnic groups as compared to the "non-hybrid" groups. These ethnic groups will be defined in detail in each report.

THE PURPOSE OF THE STUDY

We would close this brief introduction by recalling the statement of S. J. Holmes (1924) which was made almost 40 years ago in his study on University of California students:

"Of course the group studied represents a selected class differentiated in several respects from the general population. But it is a very important class. It is a class which furnishes much of our intellectual leadership and its biological trend is a matter of some moment."

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THE RELATION OF POPULATION FERTILITY LEVELS TO ETHNIC GROUP BACKGROUNDS[1, 2]

JACK B. BRESLER

Department of Biology, Brown University
Rhode Island

THE QUESTION of lowered fertility in interfaith marriages has interested social observers for some time. Analysis of the accumulated data for the study project, "The Human Biology of Academic Potential," reveals that ethnic origins figure prominently in the problem of lowered fertility of mixed or interfaith marriages. The purpose of this report is to explore the background of ethnic origins in these marriages.

Throughout the report, fertility will signify the number of live offspring.

Following Montagu, the term ethnic group will replace the much maligned and much abused "race" (Montagu, 1960). The interpretation of ethnic group is intentionally loose in definition at this beginning of the report. Various levels of ethnic groups will be recognized. Thus it will be accepted that one ethnic group may be divided into two or more ethnic groups. Sometimes an ethnic grouping will refer to individuals of the same religion, sometimes to a grouping of individuals of a similar national origin, and sometimes to groups of individuals of the same religious preference and the same national origin. At all times, however, there is recognized a certain unity of the geographical and cultural factors in the population under discussion.

[1] This investigation was supported by a research grant, B-2356, from the National Institute of Neurological Diseases and Blindness, Public Health Service.

[2] I am extremely grateful to have received the vigorous comments which Dr. George Hagy, Dr. Sidney Goldstein, and Dr. Kurt Mayer provided for an earlier draft of this manuscript. I also derived considerable benefit from the discussions following a presentation of this paper to the Seminar, Genetics and the Evolution of Man, at Columbia University.

SOURCE OF DATA

A detailed report of the various sources of data appears in the introductory report (Bresler, Dunn, Urquhart, and Smith, 1961; preceding, in this issue).

Brown-Pembroke students are required to indicate how many brothers and sisters they have at the time of their acceptance in the University. The total number of children on this entrance record represents the number of live births in the reproductive history of the students' mothers. Two assumptions are made on this point:

1. That this is the completed reproductive history of the mother. (Average age of the mothers whose data were used in the study was 45.3, while the average age of the fathers was 49.8);

2. That the loss of any live born, through either disease, accident, or other reason, is on a random basis and has affected all groups in approximately equal proportions.

A family group (to be defined) was omitted in this study if any adoption of an offspring was recorded or where second marriages were recorded for either parent.

ORGANIZATION OF DATA

The analysis in this investigation was limited to Protestants and Catholics and matings between these two faiths. It was further required that the religion be known for the F_2 generation, that is, the Brown-Pembroke alumnus (one individual), and also for the F_1 or parental generation of the Brown-Pembroke alumnus (two individuals). Unknown religious designations, no religious preference, or religious preference other than Protestant or Catholic in any of these three individuals was sufficient cause for omitting the entire family group from this analysis. This procedure of working only with individuals for whom a religious preference is known has been used previously by Hollingshead (1950). Other additional restrictions for various sections will be noted. All seven individuals in the three generations, $F_2(1)$, $F_1(2)$, and P_1 (4-grandparental generation), must have been known to be white. Unknown racial information or known nonwhite racial information was sufficient cause to eliminate the entire family group from the study.

The fertility data are available only for the completed reproductive history of the F_1 generation. These data will be presented in three levels of increasing religious homogeneity.

Level I. All F_1 and F_2 individuals are known to be either Protestant or Catholic. The P_1 generation may contain other religious preferences, no religious preference, or unknown designations. No restrictions are made upon national origin of any members in the three generations.

Almost all previous studies relating religious preference to fertility have been done at this level, and it is therefore worth while to compare these results with others.

Level II. All F_2, F_1, and P_1 individuals are known to be either Protestant or Catholic. No restrictions are made on national origin.

The population of Protestant $\times$ Protestant matings of the F_1 generation is divided into two populations designated as "All-Protestant" (A-P) and "Hybrid-Protestant" (H-P). Those F_1 Protestant $\times$ Protestant matings in which all four individuals of the P_1 or grandparental generation are known to be Protestants were placed into an A-P group. Those F_1 Protestant $\times$ Protestant matings in which one or more individuals of the P_1 generation are known to have been Catholic were placed into the H-P group.

The same comments also apply to the F_1 Catholic $\times$ Catholic matings. If all four P_1 individuals were Catholic, the mating was placed into the A-C (All-Catholic) category. If, however, one or more individuals in the P_1 generation were Protestant, the mating was placed into the H-C (Hybrid-Catholic) grouping.

The mating type, OO, as shown in Table 1, represents the A-P group, whereas the A-C group is represented by mating type 15.

The other 14 possibilities represent the "Hybrid" classes. Not all mating combinations were recovered in this study.

Thus six major groups involving Protestant and Catholic matings are distinguished. Two are "all" groups,

two are "hybrid" groups as determined by the P_1 level, and the remaining two groups are interfaith matings in the F_1 generation.

Level III. All seven individuals of the three generations P_1, F_1, and F_2 have declared religious preference either for Protestantism or for Catholicism. All individuals have been born in the United States and are white.

PRESENTATION OF DATA: LEVELS I, II, AND III

Level I. In line with previous investigations the Protestant × Protestant (P×P) matings have lower fertility than Catholic × Catholic (C×C) matings (Table 2). Matings are presented as Mother × Father.

Lower fertility in interfaith marriages is not unexpected and has been reported previously. In the Far West, Holmes (1924), using a sample of college men comparable to the F_2 in this investigation, found that completed fertility records of their mothers, F_1, did indeed show a fertility gradient of C×C> P×P> interfaith marriages. In their well-organized Midwestern sample of Indianapolis, Whelpton and Kiser (1943) and Kiser and Whelpton (1944) found essentially the same trends. Coogan (1946), in a Florida sample, found lower fertility in mixed marriages than in C×C matings. Accordingly, the trends appear to be present throughout the country.

It will be observed that in the P×P matings, 91.3% of the 723 parents are U.S. born, whereas 193 or 73.1% of the of the C×C parents are of U.S. birth (Table 3). It might be expected on a priori grounds that mixed marriages would fall somewhere near the arithmetic average of 82%. However, 90.8% of the parents who enter into mixed mar-

TABLE 1

MATING TYPES BASED UPON RELIGIOUS PREFERENCE

		F_1 Fathers			
F_1 Mothers		P_1 Mother Prot. Father Prot.	P_1 Mother Cath. Father Prot.	P_1 Mother Prot. Father Cath.	P_1 Mother Cath. Father Cath.
P_1					
Mother Prot.	Father Prot.	00	01	02	03
Mother Cath.	Father Prot.	04	05	06	07
Mother Prot.	Father Cath.	08	09	10	11
Mother Cath.	Father Cath.	12	13	14	15

TABLE 2

LEVEL I. NUMBER OF CHILDREN IN RELATION TO TYPES OF RELIGIOUS MATINGS. MATING TYPES ARE DESIGNATED AS MOTHER X FATHER. (P = PROTESTANT, C = CATHOLIC)

No. Children	P x P	P x C	C x P	C x C
1	66	7	9	22
2	160	18	21	51
3	116	8	13	28
4	39	3	5	17
5	14	1	2	4
6				3
7	1			4
8				1
9				1
10				1
Matings	396	37	50	132
Total children	967	84	120	314
Average	2.44	2.27	2.40	2.78

TABLE 3

LEVEL I. NATIONAL ORIGINS OF F_1 MOTHERS X FATHERS. MATING TYPES ARE DESIGNATED AS MOTHER X FATHER

Mating type	Individual	Total no. of individuals	Country of Birth: United States No.	United States %	Foreign No.	Foreign %
P x P	Mothers	396	362	91.4	34	8.6
	Fathers	396	361	91.2	35	8.8
P x C	Mothers	37	34	91.9	3	8.1
	Fathers	37	34	91.9	3	8.1
C x P	Mothers	50	47	94.0	3	6.0
	Fathers	50	43	86.0	7	14.0
C x C	Mothers	132	98	74.2	34	25.8
	Fathers	132	95	72.0	37	28.0

TABLE 4
LEVEL II. RELATION OF FERTILITY TO MATING TYPES IN PROTESTANT X PROTESTANT MARRIAGES

No. of children	Mating Type A-P 00	H-P 01	02	03	04	07	08	12	13	H-P Total
1	49	4			3		5			12
2	134	1	4		3	1	1	1		11
3	97	2	1	1	5			1	1	11
4	38									
5	10						1			1
6										
7	1									
Total matings	329	7	5	1	11	1	7	2	1	35
Total children	817	12	11	3	24	2	12	5	3	72
Average	2.483	1.7	2.2	3.0	2.2	2.0	1.7	2.5	3.0	2.06

TABLE 5
LEVEL II. RELATION OF FERTILITY TO MATING TYPES IN CATHOLIC X CATHOLIC MARRIAGES

No. of children	Mating Type A-C 15	H-C 05	07	09	11	12	13	14	H-C Total
1	18		1				1	1	3
2	42		2	1	1	1	4		9
3	21		2		2	1			5
4	16	1							1
5	4								
6	3								
7	4								
8	1								
9	1								
10	1								
Total matings	111	1	5	1	3	2	5	1	18
Total children	322	4	11	2	8	5	9	1	40
Average	2.90	4.0	2.2	2.0	2.7	2.5	1.8	1.0	2.22

riages, almost as high a percentage as was found in the P×P matings, were born in the U.S. It would appear then that U.S. birth of participating individuals is, if not conducive to, certainly characteristic of mixed marriages.

Level II. As in Level I, the A-P matings have lower fertility than A-C matings (Tables 4 and 5). Fertility in mixed marriages still remains below the A-P matings (Tables 6 and 7). The hybrid group, H-P and H-C, have the lowest fertility of all other groups, and the data suggest that there are four groups of decreasing fertility: A-C> A-P> Mixed P×C and C×P matings> Hybrid matings of H-P and H-C. The statistical justification for this reasoning may be seen in Figure 1.

The formula for t test is as follows.

$$t = \frac{X_1 - X_2}{\sqrt{n_1\sigma_1^2 + n_2\sigma_2^2}} \cdot \sqrt{\frac{n_1 + n_2 - 2}{n_1 \quad n_2}}$$

The t value between H-C and H-P is .59; between C×P and P×C it is .57.

The spatial arrangements in Figure 1 have the disadvantage in assuming generally equal numbers in each of the four populations. This, of course, is not so. While the fertility mean is lower in the P×C and C×P population than

TABLE 6
LEVEL II. RELATION OF FERTILITY TO MATING TYPES IN ♀♀ PROTESTANT X ♂♂ CATHOLIC MARRIAGES

No. of children	Mating type				
	01	03	05	07	Total
1		5		1	6
2	1	15		1	17
3	2	4	1	1	8
4		2			2
5		1			1
Total matings	3	27	1	3	34
Total children	8	60	3	6	77
Average	2.67	2.2	3.0	2.0	2.27

TABLE 7
LEVEL II. RELATION OF FERTILITY TO MATING TYPES IN ♀♀ CATHOLIC X ♂♂ PROTESTANT MARRIAGES

No. of children	Mating type					
	04	05	08	12	14	Total
1	1		1	5	1	8
2	4	1		12	2	19
3	2		1	10		13
4	1			4		5
5	1					1
Total matings	9	1	2	31	3	46
Total children	24	2	4	75	5	110
Average	2.67	2.0	2.0	2.4	1.7	2.39

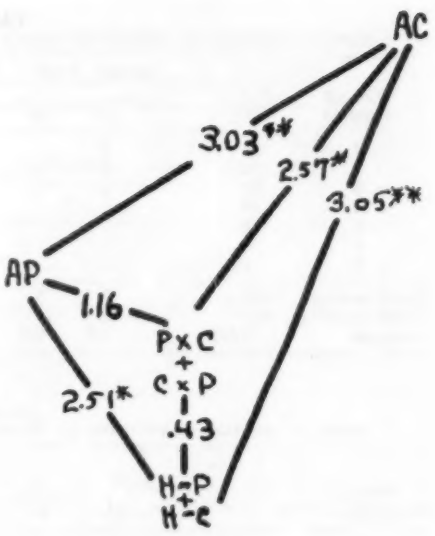

Figure 1. Level II—Spatial arrangement of t values between populations. (*Significant at .02 level; **significant at .005 level.)

in the A-P population, the former group has fewer numbers than the latter. For this reason the t score is lower between A-C and P×C + C×P than it is between A-C and A-P. The decided advantage of the arrangement is the immediate recognition of simultaneous relationships of the populations and the levels of significance among these populations.

Numerous social observers have placed the P×C and C×P matings into one category of mixed marriages so far as fertility is concerned because differences in fertility between these two mating types have rarely, if ever, been significant. Hence, as expected, the averages for these matings are almost the same, and the t score justifies this grouping. The hybrid groups show no significance between themselves, and they, too, are grouped together. The justification for this grouping is not based upon sociological foundations, since this actually means grouping of P×P matings with C×C matings. Instead, this grouping is based upon similarities in ethnic group considerations, and these will be discussed later.

Mating between U.S.-born and foreign-born individuals usually resulted in lower fertility than matings involving two U.S.-born individuals or two foreign-born individuals (Table 8). The data show this general trend or direction for each religious group. These trends are thus noted, but the numbers of matings are too small to make a conclusive statement.

Level III. In this most homogeneous level in the sample, the sequence of fertility averages resembles those found at Level II: A-C> A-P> P×C and C×P> H-P and H-C (Table 9).

TABLE 8
AVERAGE NUMBER OF LIVE BORN ACCORDING TO MATINGS BASED UPON COUNTRIES OF PARENTAL BIRTH

Matings	U.S. x U.S.		Foreign x U.S. U.S. x Foreign		Foreign x Foreign	
	No.	Av.	No.	Av.	No.	Av.
A-P	281	2.49	34	2.38	14	2.71
H-P	32	2.06	3	2.00	—	—
A-C	67	2.76	19	2.42	25	3.64
H-C	17	2.12	•	•	—	—
CxP	39	2.41	7	2.29	—	—
PxC	29	2.24	4	2.5	•	•
Total†	465	2.46	67	2.37	39	3.31

• A single mating. † Based on matings presented in table.

TABLE 9
LEVEL III. RELATION OF FERTILITY TO RELIGIOUS MATINGS

No. of children	Mating type					
	P x P		C x C		P x C	C x P
	A-P	H-P	A-C	H-C		
1	27	6			1	2
2	68	4	6	4	9	4
3	48	3	1	1	3	5
4	21		5			1
5	7				1	
6			2			
7			1			
Total matings	171	13	15	5	14	12
Total children	426	23	54	11	33	29
Average	2.49	1.77	3.60	2.20	2.36	2.42

SOCIOLOGICAL OBSERVATIONS ON HUMAN FERTILITY

It is a matter of considerable record that in the white group the average number of live-born children per couple is less today than it was 150 to 200 years ago. This is not to be interpreted as resulting from a steady or consistent decline, because from time to time there have indeed been reversals of the fertility levels. Nonetheless, the lower fertility average per couple today in contrast to former times is generally attributed to the voluntary or personal desires of the husband and wife. This curtailment has been accomplished by various means, but in the United States contraception appears to be the major factor in keeping families small (Westoff, 1953; Freedman *et al.*, 1959).

A number of reasons have been advanced for lower fertility in mixed marriages. By far the most important one concerns the alleged instabilities and poor adjustments that result from differences in religions. This in turn, it is supposed, will result in a reduction in fertility. In reviewing the literature up through the early 1940's, Kiser and Whelpton (1944) found that the available studies on the effects of differences in religion on marital adjustment provided conflicting results. A review of the literature since that time leaves the reader with the evaluation that the opinion of Kiser and Whelpton is still appropriate today. The divorce rate for mixed marriages has been regarded as an indicator of poor marital adjustment. However, Landis (1949) and Scheinfeld (1960) have commented that the divorce rate is a poor index of success or failure in marriage because it does not give a true picture of marital happiness. Furthermore, divorce rate data do not take into account the levels of toleration toward marital unhappiness.

It could be granted that in a population of mixed marriages there probably exists a slightly higher level of marital unhappiness than in a population of nonmixed marriages. This unhappiness may in turn result in lower fertility. But one thing appears certain. There is no evidence on hand which indicates the existence of large-scale marital maladjustments in mixed marriages in all parts of the country, in almost all social strata, and under almost all economic conditions. Nor is there any knowledge that these maladjustments are the demonstrable cause of considerable lowered fertility.

Another possibility relating mixed marriages to lowered fertility concerns the view toward contraception. Whelpton and Kiser (1943) suggest that Catholics involved in mixed marriages tend to be those who have departed more easily from orthodox attitudes toward contraception. This view is in order and there is little to contest it. However, valid as it may be, it does not explain why fertility in mixed marriages is so consistently lower than in P×P matings.

A pilot report of research in progress by Westoff (1959) indicates that individuals of mixed marriages desire a mean number of children which is significantly closer to, but not below, the fertility levels desired by the P×P matings than those of the C×C matings. This is a fruitful avenue of investigation.

A number of lines of evidence from sociological literature indicates that social and cultural factors contribute to the lowered fertility patterns of mixed marriages. Nevertheless, there is still lacking one or more sociological mechanisms which will consistently explain the lowered fertility pattern of mixed marriages.

THE ETHNIC BACKGROUNDS

The lowered fertility level of interfaith marriages has other complications involving the national origin of the F_1 and P_1 generations.

In a significant number of cases, interfaith marriages are in actuality international origin marriages. The two P_1 fathers for each F_1 mating (Level I) were recorded as originating either from the same country of birth or as originating from different countries of birth. The null hypothesis operating in this instance is that the ratio of like countries to unlike countries of birth is the same in each of the four religious mating combinations. The hypothesis is rejected, since there is a very substantial increase in the number of unlike combinations in the interfaith marriages (Table 10). The same results and statistical significance would have been shown had the analysis been done between the P_1 mothers or either of the two remaining combinations: P_1 maternal mother vs. P_1 paternal father or P_1 maternal father vs. P_1 paternal mother.

TABLE 10

PERCENTAGES OF P_1 FATHERS COMING FROM LIKE OR UNLIKE COUNTRIES. ($\chi^2=12.79$; $df=3$; $P<.01$.)

F_1 religious mating type: Level I	No. of matings	Like countries		Unlike countries	
		No.	%	No.	%
P x P	396	256	64.6	140	35.4
C x C	132	85	64.4	47	35.6
P x C	37	18	48.6	19	51.4
C x P	50	21	42.0	29	58.0

Previous fertility studies, especially on interfaith marriages, have not taken sufficient cognizance of these national origin aspects.

It is next fruitful to examine the results where religion is held "constant" and the F_1 national origin is allowed to vary. From all the family group data available, it was found that 329 family units involving at least seven individuals of three generations had declared a Protestant preference. This population was designated as the Protestant Line. One hundred and ten family units of seven individuals in three generations held Catholic affiliations, and they were regarded as belonging to the Catholic Line.

When the F_1 maternal and paternal birthplaces were the same, they were placed into a like national origin category. When they were not the same, they were placed into an unlike category. In Table 11, it may be observed that the average fertility in the like

TABLE 11
AVERAGE FERTILITY OF F_2 GENERATION IN RELATION TO PARENTAL COUNTRIES OF BIRTH

National origins	Protestant line		Catholic line	
	Total matings	Average fertility	Total matings	Average fertility
A. Unlike national origins	36	2.25	21	2.38
1. Neither parent U.S. born	2	2.00	2	2.00
2. One parent U.S. born	34	2.26	19	2.42
B. Like national origins including U.S. x U.S. matings.	293	2.50	89	2.94
1. Like national origins excluding U.S. x U.S. matings	12	2.83	22	3.50
2. U.S. x U.S. matings	281	2.48	67	2.76

country category is consistently higher than the fertility level in the unlike country matings. The matings are presented in greater detail in Appendices A and B.

The two foregoing developments would indicate that interfaith marriages involve a large number of interethnic origin matings and these mating types are inherently associated with lowered fertility.

Another line of evidence of ethnic group involvement is the percentage of F_1 generation individuals who have come from or have resulted from P_1 interfaith marriages. In Table 12 it will be observed that the percentage of individuals from mixed marriages increases in exactly the same sequence as was previously shown (Tables 4, 5, 6, and 7) to exist for decreasing fertility in these same four groups.

There is very little difference between the H-P and the H-C groups as regards their mixed or nonmixed derivations. Of the 70 Protestants involved in these marriages, 38, or 54%, came from nonmixed marriages, and 32, or 46%, came from mixed marriages. The group of Catholics involved in these hybrid matings show extremely similar composition. Of the 36 Catholics in the H-C group, 18, or 50%, came from nonmixed matings, and the remaining half came from mixed matings. There is hardly any difference between the two "Hybrid" groups on these considerations.

TABLE 12
PERCENTAGE OF INDIVIDUALS IN THE F_1 GENERATION WHO COME FROM MIXED AND NONMIXED P_1 MATINGS —LEVEL II

Mating type	No. of individuals	F_1 individuals from nonmixed P_1 matings		F_1 Individuals from mixed P_1 matings	
		No.	%	No.	%
AP	758	758	100.0	0	0.0
AC	222	222	100.0	0	0.0
PxC & CxP	160	136	85.0	24	15.0
H-P & H-C	106	56	52.8	50	47.2

The national origin data on the P_1 generation in the H-P and H-C groups provide essentially the same trend as indicated in Table 10; that is, an extremely large contingent of these "hybrid" groups involve mixed ethnic origins.

To sum up: It has been shown that interfaith marriages are not only interreligious marriages, but they are also by and large inter-national origin marriages. Lowered fertility, it would appear, is a characteristic of mixed ethnic origin matings.

DISCUSSION

In the past 300 years, many human isolates have broken down and their members have been more generally distributed into different and in many instances larger breeding populations. While, in the main, human evolution

is towards or in the direction of a world-wide intraspecific breeding population, it is not likely that the human species shall reach this end point in the foreseeable future. While it is probably true that there does exist a larger force or movement in the breaking down of isolates, there are also certain signs that new isolates are being built up or, in this case, segregated.

As Howells (1960) points out, there are a number of instances where national borders are "slamming shut." This may be politically questionable in these times, but it certainly is a sound genetic procedure for the isolation of breeding populations. In the U.S., processes of isolation are also in operation. Kennedy (1943) and Hollingshead (1950) indicate that strict national origin endogamy is loosening, but this is being accompanied by a building-up process along religious endogamy. A recent review on the attitudes of religious leaders toward interfaith marriages ranged from mild to vigorous opposition to such marriages (Ehrlich, 1960). On the other hand there are references in the Ehrlich article that suggest that interfaith marriages are probably increasing.

Demonstrable biological changes have been shown in populations which were isolated for religious purposes (Glass, Sachs, Jahn, and Hess, 1952; Dunn and Dunn, 1957).

In numerous respects the present investigation has bearing upon this continual dissolution and formation of isolates.

Interfaith marriages bring together in a greater degree than unifaith marriages the elements from diverse ethnic groups. The information from this study and others previously cited indicates that when comparing the fertility levels of two or more populations, the population which has the highest percentage or contingent of interethnic group matings is more likely to have the lower fertility level. This observation appears to be valid whether the ethnic groups are based upon religious or national origins.

The reasons for this lowered fertility are not completely understood at this time. Three future avenues of research are indicated.

a) *Sociological.* It would be well to investigate the sociological mechanisms which apply not only to interfaith marriages but also to inter-national origin marriages. It is not clear from previous sociological literature whether lowered fertility within a population is attributable to religious factors, ethnic group considerations, or a combination of both factors.

b) *Psychological.* It would be well to explore the emotional content of interethnic group matings. What, for example, are the relationships of emotional stress of these mixed matings to abortions and fertility?

c) *Genetic.* It would be well to explore the ramifications of the inordinate amount of genetic "mixing" in interfaith or interethnic group marriages. The matings have brought together genetic elements from diverse gene pools. Is there, for example, such a phenomenon as higher reproductive wastage and lowered fertility due to the increased population heterozygosity taking place in interethnic group matings?

The problem of lowered fertility in interethnic origin matings is probably more complex than was hitherto suspected.

Summary

1. As part of a project study on "The Human Biology of Academic Potential,"

804 Brown-Pembroke alumni supplied data on the religious preference, national origin, and racial designation for themselves (F_2 generation—1 individual), their parents (F_1 generation—2 individuals), and their grandparents (P_1 generation—4 individuals). The number of siblings which they indicated on their freshman entrance applications was taken as the completed fertility record of their parents.

2. The data were analyzed for 615 family groups (seven individuals) who held preferences for Protestantism or Catholicism. All individuals under discussion were white.

3. Catholic matings showed the highest fertility levels, followed by Protestant matings, and lastly by interfaith marriages.

4. The social factors which could be responsible for reduced fertility in interfaith marriages were examined. It is pointed out that these factors do not adequately explain this consistent phenomenon of reduced fertility in these matings.

5. It was shown that interfaith marriages are in most cases inter-national origin matings. The inadequacies of viewing interfaith fertility data from an exclusively religious viewpoint are discussed.

6. In one series the religious preference was held "constant" for the seven individuals in the three generations, and a Protestant Line and a Catholic Line were developed. In both series, matings between individuals of like national origins showed higher fertility than matings involving individuals of different national origins.

7. The relationship of lowered fertility in interethnic origin matings is quite complex, and three avenues for future research in this area have been suggested.

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APPENDIX A

NUMBER OF F_1 MATINGS IN THE PROTESTANT LINE. PARENTAL COUNTRIES OF BIRTH ARE INDICATED

	P_1 Fathers								
P_1 Mothers	U.S.	England	Canada	Scotland	Germany	Norway	Sweden	Nether-lands	Union of So. Africa
U.S.	281	6	4	3			1	1	1
England	7	2							
Canada	5		2						
Scotland				3					
Germany					3				
Norway	2					2			
Sweden		1							
Switzerland	1				1				
Cuba	1								
Finland	1								
North Ireland	1								

APPENDIX B

NUMBER OF F_1 MATINGS IN THE CATHOLIC LINE. PARENTAL COUNTRIES OF BIRTH ARE INDICATED

	F_1 Fathers								
F_1 Mothers	U.S.	Italy	Canada	Lithuania	Germany	Ireland	Poland	Portugal/ Azores	Panama
U.S.	67	7	3	1				1	
Italy	2	14							
Canada	1		1						
Lithuania				2					
Germany			1		1				
Ireland	2					1			
Poland							1		
Portugal/ Azores	1							1	
Panama									1
Finland					1				
Hungary	1								

RECENT DEVELOPMENTS IN HUMAN CYTOGENETICS[1]

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INTRODUCTION

That human somatic cells contain only 46 chromosomes was discovered in 1956 (Tjio and Levan, 1956). This discovery was based on a few simple technical innovations: (1) the use of tissue culture to obtain a monolayer of dividing cells, (2) the use of colchicine to obtain larger numbers of dividing cells at metaphase, (3) hypotonic treatment of these cells prior to fixation, (4) flattening of the cells to spread the chromosomes in a single optical plane, and (5) photographic karyotype analysis.

Cells to be grown in culture can be obtained from bone marrow (Ford, *et. al.*, 1958), solid tissues (Puck, *et al.*, 1958; Harnden, 1960) or peripheral blood samples (Hungerford, *et al.*, 1959). A standard system of nomenclature for the human chromosomes, the Denver classification, has been prepared by a group of workers in this field (Denver, 1960). The chromosomes are divided into seven groups; the chromosomes within some groups can be distinguished with difficulty or not at all.

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Chromosomal abnormalities were first found in association with mongolism and Klinefelter's syndrome. Several mongols were shown to be trisomic for chromosome number 21 of the Denver Classification (Lejeune, *et al.*, 1959); and a chromatin-positive man with Klinefelter's syndrome, found to have 47 chromosomes, had a probable XXY sex chromosome constitution (Jacobs and Strong, 1959). A man with both these syndromes had 48 chromosomes, with 21-trisomy and XXY (Ford, *et al.*, 1959*a*). A chromatin-negative woman with Turner's syndrome (gonadal dysgenesis) had only 45 chromosomes in each metaphase cell, with a probable XO sex chromosome complement (Ford, *et al.*, 1959*b*).

Many further chromosomal abnormalities have now been reported, involving chromosome number, mosaicism, or gain, loss or interchange of chromosomal material, e.g., translocations. These findings will be reviewed in the succeeding sections of this paper, and some attempt made to show how these abnormalities may have come about. We have recently prepared a fuller review of the methods and some of the results and theoretical interpretations in this field (Hirschhorn and Cooper, 1961*a*).

AUTOSOMAL ABNORMALITIES

Trisomy. In addition to mongolism, two well-defined syndromes associated with specific autosomal trisomy have

been described. Edwards *et al.* (1960) reported the first, a child with 47 chromosomes and the following clinical features: small triangular mouth, low-set slanting ears, flat and broad nasal bridge, webbed neck, hyperflexibility, webbing between the second and third toes, cyanotic congenital heart disease, a shield-like chest with lateral nipples, and characteristically clenched fists. Since the first description, at least eleven cases have been found (Edwards, 1961; Smith, *et al.*, 1960; Hirschhorn and Cooper, 1961*b*). Edwards describes the chromosome appearing in triplicate as chromosome number 17, while Patau prefers to call it chromosome number 18. We cannot make a decision one way or another, and prefer to call this a trisomy for a chromosome of the group 17-18.

Patau *et al.* (1960) reported another syndrome in two children with 47 chromosomes and the following clinical features: cerebral defect, anophthalmia (microphthalmia has also been found), cleft palate and harelip, simian lines, "trigger" thumbs, polydactyly, capillary hemangiomata, and congenital heart disease. Several of these cases have now been found. The triplicated chromosome in this case is one in the group 13-15.

There have been several other reports of trisomy in single individuals. Hayward and Bower (1960) have found three chromosomes (number 22) in one case with the Sturge-Weber Syndrome, but this has not been confirmed. Fraccaro *et al.* (1960*c*) reported trisomy of chromosome number 19 in a supposedly normal man, whose mongol child also was said to have three number 19 chromosomes but only one chromosome number 21. Böök and Santesson (1960*a*) reported a mother and son whose only apparent pathology was an inter-atrial septal defect. Both individuals were trisomic for a chromosome in the group 19-20, while the son was also monosomic for one of the chromosomes of group 21-22. Böök *et al.* (1961) also described a woman with familial inter-atrial septal defect and chromosomal mosaicism. Some of her cells had 46 chromosomes and others 47 chromosomes. The latter were trisomic for one of the chromosomes in group 6-12. This woman's daughter is clinically normal, has 46 chromosomes and demonstrates a translocation between a chromosome number 2 and a chromosome in group 6-12. Other reports of translocations and mosaicism will be discussed below. Böök and Santesson (1960*b*) also reported a case of multiple malformations in a man whose skin cells had 69 chromosomes, or a triploid number, with each autosome present in triplicate and a sex chromosome constitution of XXY. His bone marrow cells, however, were normally diploid.

The occurrence of mongolism and Klinefelter's syndrome in the same individuals has been described in two cases (Harnden, *et al.*, 1960; Lanman, *et al.*, 1960). Each of the individuals had 48 chromosomes, with the expected trisomy of chromosome number 21 and a sex chromosome constitution of XXY. It is not known whether this represents coincidence or the presence of factors predisposing the gametocytes of one parent to an increased frequency of nondisjunction.

Translocations. Turpin *et al.* (1959) first described an individual having 45 chromosomes, probably as the result of a reciprocal translocation. The individual was missing one each of chromosomes number 13 and 21, but had an extra chromosome apparently made up of the long arms of these two chromosomes, joined together at the

centromere. The authors attribute the patient's clinical syndrome, which they call polydysspondylism, to the loss of the genetic material on the short arms of the translocated chromosomes. In view of the apparently sizable number of normal individuals with similar translocations (see below), the possibility of coincidence must be considered. Lejeune *et al.* (1960) have reported a case of Klinefelter's syndrome with 46 chromosomes, one of which consisted of the reciprocally translocated long arms of two chromosomes in the 13-15 group joined at the centromere.

The most common translocations have been reported in certain mongols with 46 chromosomes and, in some cases, in their asymptomatic relatives, who had 45 chromosomes. The first case was described by Polani *et al.* (1960), who found a mongol girl with 46 chromosomes. Five of the chromosomes were group 13-15, two were number 21 chromosomes, two were number 22 chromosomes and there was an extra chromosome, representing the translocated long arms of the third chromosome number 21 expected for mongolism and the missing chromosome from group 13-15. Several similar cases have been reported, including chromosome analyses of the families (Penrose, *et al.*, 1960; Carter, *et al.*, 1960; Breg and Miller, 1961). In the first of these reports, the sister, mother and maternal grandmother were all normal but had 45 chromosomes, with the same translocation product as the male and female mongol sibs with 46 chromosomes. The family reported by Carter *et al.* was similar, and also included several mongols.

Breg and Miller (1961) have described the only normal male with 45 chromosomes and the typical translocation chromosome. His wife's two pregnancies terminated prematurely, the infants dying after a few hours. Stillbirths and deaths in early infancy, as well as mongolism, appear to have an increased incidence in the pregnancies of females with this translocation. Since the abnormal meiotic pairing of chromosomes in a person who is heterozygous for the 15-21 translocated chromosome probably leads to an increased incidence of triplo-21 mongols, it seems likely that triplo-15 individuals may also be produced, and may be represented in the group of stillborn infants.

Translocations can best be recognized by demonstrating typical translocation figures in meiotic chromosomes, but only one report of such a study has appeared (Miller, *et al.*, 1960). Testicular biopsies of four mongols were examined. In two of these biopsies, abnormalities suggestive of translocation figures were seen. Mitotic chromosome analysis of one of these two individuals showed the presence of 46 chromosomes (plus a minute fragment) and a probable 21-22 translocation (Penrose, *et al.*, 1960).

Hirschhorn and Cooper (1961*b*) have recently found this type of translocation with the long arms of a chromosome number 21 and a chromosome number 22 joined in mitotic metaphase cells from blood and skin cultures of a mongol boy with acute monocytoid leukemia. Both parents and all siblings were normal, with 46 chromosomes. Buckton *et al.* (1961) have also reported a case of acute lymphatic leukemia in a non-mongol sibling of a mongol with a 15-21 translocation; their normal mother had 45 chromosomes and the 15-21 translocation. It will be of interest to observe whether the high incidence of leukemia in mongols may be related to the presence of a translocation.

ABNORMALITIES INVOLVING THE SEX CHROMOSOME

Most of the known chromosomal abnormalities in man involve the sex chromosomes. There are three main classes, which have their characteristic causes: (1) abnormalities of chromosome number, due to meiotic nondisjunction; (2) chromosomal mosaicism, due to somatic nondisjunction or to chromosome loss in a fraction of the cells; and (3) interchange, gain or loss of chromosomal material, due to other causes.

Abnormalities of number. Turner's syndrome and Klinefelter's syndrome were the first conditions in which sex chromosome abnormalities were found (XO and XXY, respectively). The occurrence of XO and XXY individuals can be explained on the basis of primary nondisjunction in the ovary of the mother. If this occurred at the first meiotic division, O- or XX- containing ova would be produced. When fertilized by X- or Y- bearing sperm, these would give rise to XO, YO, XXX or XXY zygotes. Discovery of an XXX female (Jacobs, *et al.*, 1959) strengthened this concept of the mode of origin of such cases. The occurrence of XXXY males (Ferguson-Smith, *et al.*, 1960; Barr and Carr, 1960) is also explicable if the same type of nondisjunction also occurs in the testis of the father.

A broader causal framework is necessary to account for the XXYY males who have now been found (Muldal and Ockey, 1960; Barr and Carr, 1960; Ellis, *et al.*, 1961). If nondisjunction can occur at the second meiotic division in the testis, XX- or YY- bearing sperm can be produced, making possible not only XXYY but also XXXX and XYY individuals. Two XXXX females have now been reported (Barr and Carr, 1960), lending credence to this scheme.

However, even this scheme will not account for the occurrence of XXXXY males with 49 chromosomes (Fraccaro, *et al.*, 1960*d*; Miller, *et al.*, 1961*b*). If nondisjunction at the first meiotic division can be followed by nondisjunction at the second meiotic division, however, XXX- and XXY- bearing sperm could be produced, and a variety of sex chromosome complements, including XXXXY, could occur at fertilization.

The discovery of these sex chromosomal abnormalities has been carried out primarily by screening mentally defective populations by interphase chromatin tests, usually based on buccal smears. Although genital abnormalities may occur in patients with chromosomal abnormalities, sexual development is usually normal, and fertility has been reported in several XXX individuals (Fraser, *et al.*, 1960; Jacobs, *et al.*, 1960; Stewart and Sanderson, 1960) and in one XO individual (Bahner, *et al.*, 1960). If the interphase chromatin pattern and the presence of a male, female or intersexual phenotype are used as the basis for classifying the chromosomal abnormalities (Table 1) several points are emphasized. First, the Y- chromosome appears to be strongly male-determining, since the presence of a single Y- chromosome leads to a male phenotype even if there are as many as 4 X-chromosomes in the karyotype. Second, there appears to be a constant relationship between the number of X- chromosomes and the maximum number of interphase chromatin masses (Barr bodies, or sex chromatin masses), i.e., there is one less interphase chromatin mass than there are X-chromosomes.

A possible exception to this rule is a

TABLE I.
SEX CHROMOSOME, SEX CHROMATIN PATTERN AND SEXUAL PHENOTYPE IN MAN

Sex Phenotype	Sex chromatin pattern			
	–	+	++	+++
Female	XO	XX XO?	XXX	XXXX
Male	XY	XXY XXYY	XXXY	XXXXY
Intersexual	XO?			

group of three chromatin-positive women with gonadal dysgenesis, who, in long-term cultures of skin showed only XO cells with 45 chromosomes (Grumbach, *et al.*, 1960). It seems likely that these cases are really chromosomal mosaics, probably XO/XX. However, Barr bodies were seen in some of the nuclei in these long-term cultures, lending support to the authors' hypothesis that the presence of a single X-chromosome is sufficient for the appearance of the sex chromatin mass. An objection to this could be raised, since the interphase chromatin pattern of cells in culture is not perfectly correlated with the chromatin pattern of uncultured cells. Thus, in one patient with 49 chromosomes, Fraccaro *et al.* (1960*d*) found three Barr bodies in a proportion of buccal mucosal cells but only one Barr body per nucleus in long-term cultured cells. It is likely that the female patients with 47 chromosomes reported by de Carli *et al.* (1960) and by Sandberg *et al.* (1960*a*) as examples of autosomal trisomy are really trisomic for the X-chromosome, since both patients were chromatin-two-positive. Crooke and Hayward (1960) determined the karyotype of a man who was chromatin-two-positive. Bone marrow culture produced an almost equal number of XX cells with 46 chromosomes and XXY cells with 47 chromosomes. In the face of these exceptional cases, no general conclusions about the relations of the various sex chromatin patterns to the X-chromosome complement seem warranted at this time.

The third point which could be made from Table I is that these abnormal sex chromosome complements, errors of sex determination, do not affect sex differentiation. The exceptions to this are (1) females with a single X-chromosome in their karyotype; they usually have abnormal (dysgenetic) gonads with ovarian stroma and sometimes even a few seminiferous tubules with otherwise female phenotype; and (2) chromosomal mosaics, one of whose two or more karyotypes is characteristically associated with feminine development, and another with masculine development; the resultant phenotype may be intersexual (vide infra).

Mosaicism. Soon after discovery of individuals with XXY and XO sex chromosome complements, Ford and co-workers, using short-term bone marrow cultures, found individuals with the same clinical syndromes who had two cell types with respect to chromosome number and karyotype. A chromatin-positive male was a mosaic of XXY- and XX- containing cells (Ford, *et. al.*, 1959*c*). One chromatin-negative and two chromatin-positive females with Turner's syndrome were XO/XX mosaics (Ford, 1959). Further reports of mosaicism in Klinefelter's syndrome (Nowakowski, *et al.*, 1960) and in Turner's syndrome, or gonadal dysgenesis (Fraccaro, *et. al.*, 1960*a;* Sandberg, *et al.*, 1960*b*), leave little doubt as to the reality of this phenomenon. The two or more cell types are not always demonstrable in a single culture, even of blood or bone marrow. Consequently, the presence of mosaicism cannot be ruled out unless

cultures are made from multiple sites or tissues; even then, mosaicism cannot be completely dismissed.

There are two main types of mosaicism: that in which the two cell lines differ by a single chromosome, and that in which they differ by a pair of homologous chromosomes. The former is produced by a process of chromosome loss, e.g., by anaphase lag; the latter is produced by somatic, i.e., mitotic, nondisjunction, and can give rise to complex mosaics with three or more cell lines if nondisjunction occurs at the 2-cell stage or later in embryonic development.

Chromosome loss from an XX zygote would give rise to an XO/XX mosaic; from an XY zygote, either an XO/XY or YO/XY mosaic. The viability of YO cells, even in a YO/XY organism, is highly dubious, and the fate of a two-celled embryo composed of one viable and one inviable cell is also questionable. However, XO/XY mosaics may be relatively common; we (Hirschhorn, *et al.*, 1960; Miller, *et al.*, 1961*a*, *c*) have described three such cases, and Blank *et al.* (1960) another. All were chromatin-negative and all had intersexual phenotypes. One of the patients was masculinized but had female genital structures except for a right-sided gonadal mass made up of abundant clumps of Leydig cells, abnormal seminiferous tubules, a small bit of ovarian stroma and a large seminoma. The left gonad was absent. We found about equal numbers of XO and XY cells in repeated blood cell cultures, but only XO cells in a long-term culture of tissue from the left gonadal area (Miller, *et al.*, 1961*c*).

Similar clinical abnormalities were present in two individuals who were reported to be XO from the analysis of cells from a skin biopsy in one case (Bloise, *et al.*, 1960) and from bone marrow in the other (Ferguson-Smith and Johnston, 1960). It is likely that both these individuals are XO/XY mosaics. It also seems likely that any analysis carried out on a single tissue may fail to reveal mosaicism and therefore will give misinformation on the frequency of the various types of chromosomal abnormalities.

Somatic, or mitotic, nondisjunction is the process by which a cell gives rise to two cell lines which differ by two homologous chromosomes, i.e., one daughter cell has lost a chromosome, which has been incorporated in the nucleus of the other daughter cell. For example, an XX zygote may produce XO and XXX daughter cells by somatic nondisjunction. If this had not occurred until the 2-celled stage or later, then a proportion of the cells would still be XX, and the organism would be an XO/XX/XXX mosaic.

Somatic nondisjunction is thus a cause of chromosomal mosaicism, the complexity of which depends upon the karyotype of the zygote, the number of cells in the organism when nondisjunction occurs, and the selective value of the various cell lines in the given environment. Jacobs *et al.* (1960) examined metaphase chromosomes in cultures from four different tissues of an XO/XXX mosaic. Examination of only one tissue could have led them to the wrong interpretation of this individual's chromosomal abnormality.

Four types of mosaicism can occur as a result of mitotic nondisjunction in an XY zygote: XO/XYY, XO/XY/XYY, YO/XXY and YO/XY/XXY. It is impossible to predict whether YO cells would be viable in such a mosaic embryo, or what effect such cells, viable or inviable, would have on the developing organism. We have recently found a case

of XYY/XO mosaicism (Cooper, *et al.*, 1961). The chromatin-negative patient had a female phenotype, primary amenorrhea and absence of secondary sexual development. A diagnosis of gonadal dysgenesis was made, and was confirmed by finding typical streak gonads at laparotomy. Peripheral blood cell culture and chromosome analysis revealed only cells with 47 chromosomes and XYY sex chromosome complement. Long-term cultures of skin showed the presence of both XO and XYY cells, with a preponderance of the XO type. It seems likely that the gonadal anlagen consisted predominantly of XO cells, although all that we can really say is that the region which mediates the male-determining action of the Y chromosome was probably composed of XO cells. Since this action need only involve testicular differentiation and must at least involve this, the simplest explanation of the findings in this case is that the gonadal primordia were made up predominantly of XO cells, as we found in the XO/XY mosaic discussed above.

Interchange, gain or loss of chromosomal material. Deletion of a portion of a human chromosome has not been proven. However, Jacobs *et al.* (1960) have reported a mitotic chromosome analysis which they interpret as showing a deletion of a portion of the long arm of one of the X-chromosomes. The patient had gonadal dysgenesis and buccal mucosal cells showed 7 per cent very small chromatin masses, i.e., neither chromatin-positive nor chromatin-negative.

Another type of chromosome anomaly has been found in three chromatin-positive patients with gonadal dysgenesis (Fraccaro, *et al.*, 1960*b*). All had a chromosome number of 46, but with an additional chromosome in group 1-3 and one too few in group 6-12 (plus X). Fraccaro interpreted this to mean that one X-chromosome was much larger, probably as the result of an abnormal division at the centromere, producing an iso-chromosome X with identical arms.

NORMAL VARIATIONS

Our concept of the normal human karyotype is based on the analysis of mitotic chromosomes in rapidly growing tissues (bone marrow, etc.) or tissue cultures of solid tissues, bone marrow or peripheral blood. Karyotypes from all these tissues, and from many normal individuals, are quite similar. However, the techniques now in use are relatively crude, and relatively large variations in the karyotype might go unnoticed. The gradual improvement in methods, particularly in blood cell cultures, has made it possible to detect some variability within the normal karyotype.

One variable was noted almost as soon as the peripheral blood technique was applied. The small satellite bodies present on some or all of the acrocentric autosomes (Fig. 1) are much more prominent in peripheral blood preparations than in those from skin or bone marrow. It has also been possible to observe asymmetry of these satellites, where one member of a pair of acrocentric chromosomes carried considerably larger satellites than its presumed homologous partner (Fig. 1). Such "giant satellites" were first reported by Tjio *et al.* (1960), who found them in two patients with Marfan's syndrome. Similar satellite variants have been reported by Chu (1961) and Buckton and Harnden (1961). In each case the enlarged satellites were found in subjects with congenital abnormalities. Except for Chu's cases, no family studies were done. In Chu's cases, the variation may be one involving the short arms of chromosome

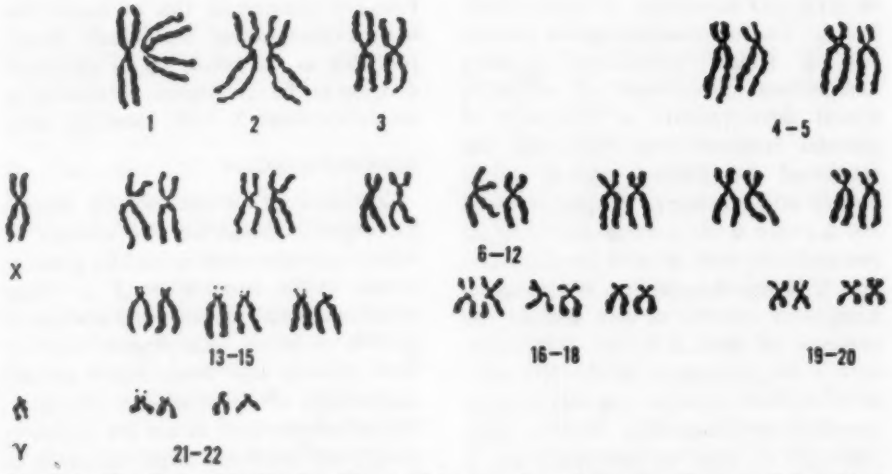

Figure 1. The Denver classification, illustrated by metaphase chromosomes from a cell in a blood cell culture of a male. Satellites are prominent on five of the chromosomes in group 13-15 and on only one chromosome in group 21-22. x 1400. (Karyotype prepared from a photograph taken by W. R. Breg.)

22, rather than the satellites. We have found two families in which such giant satellites appear to have been transmitted from a normal parent to three of four children (Cooper and Hirschhorn, 1961). In each family the index patient was phenotypically abnormal and carried giant satellites. One parent and two of three sibs in each family also carried the satellites. They were clinically normal. Such giant satellites appear, then, to be a structural chromosomal variant within the range of normality. They may actually be a size variant of normal satellites, or they may represent minor translocations of chromosomal material. In the latter case, the giant satellites might be compatible with normal development, but also conducive to abnormalities of the offspring such as those found in the reported cases. These abnormalities may arise through the possession of excess or deficient quantities of genetic material presumably carried in the translocated giant satellites. The mechanism of such variable distribution in translocations has been described by Carter *et al.* (1960) in a discussion of familial mongolism associated with 15/21 translocation. This may be the explanation of the fact that in Chu's case with giant satellites there were several mongoloid idiots in one family, none of whom had trisomy for chromosome 21, but all of whom had giant satellites, presumably on chromosome 22. The frequency of this and other types of minor variants will be determined only by study of unselected normal individuals.

Giant satellites may be important for another reason. Since they are transmitted with the chromosomes carrying them, giant satellites may serve as chromosomal markers. Demonstration of linkage between them and known genetic traits may then localize specific genes on specific chromosomes. This would be an important step toward human chromosome mapping.

LEUKEMIA, RADIATION AND CANCER

Another application of the techniques of human chromosome examination has been the attempt to find a possible relationship between leukemia and chromosomal aberrations. Baikie *et al.* (1959) reported several cases of acute leukemia in whom short-term bone marrow cultures revealed nonspecific chromosomal aberrations in many cells. Sandberg *et al.* (1960*b*) reported similar findings. They found no abnormalities in their cases of chronic leukemia. Later, Nowell and Hungerford (1960) and Baikie *et al.* (1960) reported that, using the peripheral blood technique, they consistently found an unusually small chromosome in subjects with chronic myeloid leukemia. Nowell's group interpreted this as an unusually small Y chromosome, while Baikie's group considered it a number 22 chromosome with a deletion in the long arm. No abnormality was found in cells from skin cultures. If this is verified by future work, it is a very exciting advance in the understanding of the pathogenesis of chronic leukemia. It remains to be determined whether the aberration arises in a clone of atypical cells overgrowing the normal bone marrow population, or whether mosaicism is present and the atypical cell represents the true cell type of the hematopoetic tissue which predisposes to the development of chronic leukemia.

The frequently reported association between radiation and leukemia, and the demonstration of chromosomal defects induced by irradiation *in vitro* (Puck, 1960) have prompted investigators to examine the effects of heavy doses of therapeutic radiation on chromosomes *in vivo*. Tough *et al.* (1960) investigated a series of subjects receiving radiotherapy for ankylosing spondylitis. Serial studies of chromosomes from peripheral blood revealed a sudden appearance of cells with a variety of chromosomal aberrations immediately after radiation exposure. These gradually diminished over a period of several weeks. This direct demonstration of abnormalities of chromosomes induced by radiation is highly suggestive, in view of the reported high incidence of leukemia in patients with ankylosing spondylitis treated by radiotherapy (Graham, 1960).

Miller (1961) demonstrated a significant increase in the proportion of metaphase cells with more than the modal number of chromosomes in blood cell cultures of some patients with gonadal or uterine cancers. Whether some of these aneuploid cells were cancer cells, or whether a difference in the plasma of some of these cancer patients is responsible for the increased heteroploidy, remains to be determined.

SUMMARY

Recent developments in human cytogenetics have been reviewed. The use of blood cell cultures as a source of mitotic cells has resulted in new knowledge of chromosomal detail and has greatly extended the applicability of chromosome analyses. As more family studies are carried out, the genetic basis of the variability of the chromosomes, e.g., the satellites, is coming more clearly into view.

Several new autosomal trisomic syndromes have been discovered. However, new sex chromosome abnormalities are still being discovered at a more rapid rate.

More examples of sex chromosomal mosaicism have been reported, some of them only discovered by the examination of two or more tissues or biopsy sites.

This technique is rapidly becoming essential for definitive study of a new case. The investigation of chromosomal aberrations in leukemia, other forms of cancer, and after radiation exposure has developed as a useful approach to these problems.

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HEREDITY AND PRODUCTIVITY IN FAMILIES OF INSTITUTIONALIZED DEAF

PERRY CLOSE

Abstract of an unpublished dissertation on file at the University of Texas, Austin, Texas, 1955

A study has been made of 2802 index cases* based upon student application and medical records at the Texas School for the Deaf in Austin, Texas to determine if there has been an increase in hereditary deaf children over the past seven decades beginning in 1881. Deafness was considered to be hereditary only if more than one member of a sibship was affected or if one or both parents of a deaf child were affected. Both dominant and recessive types of hereditary deafness were included.

It was found that the proportion of index cases in families containing hereditary deaf children produced by hearing parents among all index cases of relevant size in the school has not increased, while the proportions of index cases in families containing hereditary deaf children produced by one or two deaf parents among all index cases in the school have shown a slight increase.

It was found that deaf persons marry less frequently than do hearing and that they marry later when they do marry. Deaf parents of hereditary deaf children have comparatively smaller family sizes than do hearing parents of deaf children. A definite positive selection of deaf persons by other deaf in marriage was found.

It is doubtful that increases in the proportion of index cases produced by one or two affected parents could have taken place by the production of deaf children by deaf parents generation upon generation in view of the reduced fecundity of the deaf. Such increases may be accounted for by the additional production of families having at least one deaf child by one or two deaf parents who were themselves the children of hearing parents.

Earlier workers predicted the number of deaf persons would increase rapidly as a consequence of additional deaf children produced by matings between two deaf persons. The fact that the rate of increase is only slight may be explained by the comparatively low probability of matings between the hereditary deaf since (according to this study) the hereditary deaf make up only about 35% of all deaf.

Rapid increase in the proportion of hereditary deafness may yet come about in the future as the reduction of environmental causes increases the probability of matings between hereditary types.

*Each index case consists of the eldest affected member of a sibship.

Book Reviews

THE FUTURE OF MAN: P. B. Medawar. Basic Books, Inc., New York, 1960, 128 pp., $3.00.

In this day and age, one approaches a volume entitled *The Future of Man* rather gingerly, with a sense of foreboding that the author is making a prognosis based on the current set of grim alternatives facing society. This, however, is far from the intent of the author, Dr. Medawar. He leaves to others the controversial issues of the day that press for an early answer and pursues the controversial and difficult issues that arise in attempting to understand the evolutionary forces acting on man. In doing so, Dr. Medawar infuses the questions and the probes for answers with a spark of excitement and sense of reality that should delight both the professional and nonprofessional.

The Future of Man is a collection of the six BBC Reith Lectures given by P. B. Medawar, the distinguished biologist, in the winter of 1959. Toward the end of 1960, almost coincidental with the publication of his book, Dr. Medawar became a Nobel Prize winner. Thus, the book is the product of one of the world's outstanding scientists who has assumed the role of "human biologist." As Dr. Medawar explains, this requires being "demographer, geneticist, anthropologist, historian, psychologist and sociologist all in one, and much else besides; he must also be a fairly reasonable sort of human being." To this description he adds the warning "and no one can be all of these things."

Dr. Medawar's main concern in this series of lectures is with "the process of reasoning rather than with the finished products of thought." Opinions are expressed about the weight of evidence on an issue, but the author makes it clear that his purpose is not to foretell how the future will evolve. This position is taken despite the subtitle on the book jacket, "Predictions of a Biologist." In fact, the first lecture is devoted to the "fallibility of prediction" in which the painful experience of demographers in forecasting the course of fertility is cited as an object lesson of the limitations inherent in problems of a high degree of complexity.

The lectures that follow deal with a number of questions that have been repeatedly raised in the past and still cause anxiety in some circles. For example, Dr. Medawar asks "is there any real reason to suppose that advances in medicine and hygiene are undermining the fitness of the human race? And is man potentially capable of further evolution or must we suppose that his evolution has come to an end?" Dr. Medawar brushes aside superficial and pat answers to these and other questions, including those concerned with the possible "biological evils" of birth control. His conclusions are almost uniformly positive. Pointing to the inconsistencies found in nature between an inborn resistance to a particular disease and so-called "general soundness of body," Dr. Medawar indicates the futility and narrowness of worries about the negative effects of medicine and hygiene. The more useful preoccupation is finding cures for genetic defects, all of which he speculates "must have an accidental or

unpremeditated or casually intrusive quality . . . ; for it is impossible, indeed self-contradictory, that any animal should have evolved into the possession of some complex and nicely balanced genetic make-up which rendered it unfit."

In a similar positive vein, Dr. Medawar confers the title of "amateur" on the human race's status in genetical evolution. The necessary condition of "a luxuriance of inborn diversity" for evolving radically exists and the maintenance of this diversity appears to be assured. Even when discussing what is taken by him as evidence of a decline in intelligence, he comments that this situation may be only "a short-lived episode" in the transition to a more general pattern of fertility control, and in any event, it can be modified through economic actions.

The threads of Dr. Medawar's argument are brought together in the final lecture. His optimism and hope stem from the thought that we are subject to two systems of heredity, the genetic which we have in common with other animals and the nongenetic (consisting of knowledge, skills, customs, etc.) which is peculiar to man and by which he can influence posterity. This is not a novel idea, but it is instructive that a distinguished biologist places heavy emphasis on concepts which, in effect, reject the notion that nature knows best and challenges us to find ways of making nature do a better job. In short, man is the master of his future rather than the victim of immutable biological laws. It is clear why Dr. Medawar refers to himself as a "human biologist."

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TEACHING LEFT-HANDED CHILDREN: Margaret M. Clark. Philosophical Library, Inc., New York, 1961, 44 pp.

This concise well-written resumé of an earlier report on the hand preference of primary school children is combined with a guidance program for those concerned with the left-handed child and his problems.

The incidence of left-handedness in a Scottish school population is estimated by the author on the basis of teacher reports on the hand used for writing. Or 2945 boys 8.0 per cent were classified as left-handed, while the corresponding figure for girls was 5.9 per cent. Comparison with a previous study of Scottish school children indicates an increase in the frequency of left-handed girls.

Only one page of the book is devoted to a discussion of the inheritance of a hand preference. In that brief space it is stated that handedness appears to be a quantitatively inherited trait interacting with environmental variables. This view is consistent with the finding from family data that the hand preference of an individual is a result of both his genetic endowment and his early training in the home.

The remainder of the book is a careful evaluation of the literature on developmental difficulties of special interest to those working with left-handed children. The problem areas covered include reading, writing, mirror writing, and stuttering. The author believes that there is no essential difference apparent between left- and right-handers except for their use of a different hand. Many left-handers are able to change their hand preference with relative ease. For the remainder, problems are created either by those trying to make them conform, or by the inconsistent methods

used in training the left-hander to use his left hand.

This small volume will prove valuable to teachers, guidance advisors, psychologists, and parents to help them understand and work through the problems that arise in the adjustment of the left-handed child to our right-handed society.

For the sake of completeness it should be mentioned that the literature on hand preference is vast and inconsistent. The proportion of left-handers has been shown to vary from 2 per cent to almost 30 per cent. Some investigators find almost twice as many left-handed males as females, while others obtain no major handedness differences between the sexes. In general, it does appear that the more varied the test questions, the smaller the differences between the proportions of male and female left-handers. Disparity in the various percentages of left-handers is apparently a consequence of both the particular handedness criteria used and the method of data collection.

ARTHUR FALEK

HUMAN ECOLOGY AND HEALTH: An Introduction for Administrators: Edward S. Rogers, M.D., M.P.H. The Macmillan Company, New York, 1960, 334 pp., $7.75.

The title of this book is misleading. It does not present an analysis of ecological processes or a treatment of specific problems in the ecology of health and disease. For example, there is no reference to important recent studies on the ecology of mental disease. The ecology of health is an emergent discipline of great significance. A comprehensive exposition of present knowledge in this field would be a great contribution. Perhaps the author will provide such a contribution in a future publication. According to the Preface, "Furthermore, there are some potential aspects of the ecologic approach to health that it has not been possible to include at this time. A second volume dealing with these is in preparation." The present book seems to be a series of lecture notes, statistical tables, and selected readings for a course on the "Background for the Study of Public Health and Medical Administration"—the title used in preliminary editions.

The selected readings and tables, which occupy 40 per cent of the text, cover a wide range of topics from philosophical essays on the concept of health and discussions of Malthusian theory to notes on the definition of statistical indices such as mean, median, mode, crude birth and death rates, age-adjusted death rates, morbidity prevalence rate, et cetera.

The main text is in three parts. Part I is concerned with demography, including general population theories and the composition and characteristics of the population of the United States. Part II, "The Health Status of the Population of the United States," is mainly a presentation of recent vital statistics. Part III, which is restricted to twenty-four pages, deals with general principles of the relationship between environment and health. Environment is defined very broadly. "Environmental factors having possible effect on health status" include, in their "material" aspects, "intrinsic factors: age, sex, hereditary characteristics (genotype)," as well as "extrinsic factors": physical environment, biological environment, and social environment. The "non-material" environment also includes "intrinsic factors," i.e., "inherent mentality and temperament,"

as well as "extrinsic factors" such as notions and ideologies, values and goals, and life experiences such as socialization, education, trauma, and stress. The author presents alternative treatments of many of the problems considered. There is nothing in this book to which anyone can reasonably object.

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MY NAME IS LEGION. Foundations for a theory of Man in relation to Culture: Alexander H. Leighton. Volume I.

This is the first of three volumes dealing with the so-called Stirling County Project, preceded by a number of conceptual pilot studies collected in the well-known book *Explorations in Social Psychiatry* (1957).

The project itself, a big population study conducted in Nova Scotia, aims at elucidating the ambiguous problem of sociocultural influences on psychiatric disorder.

As is well known to the readers of this periodical, the psychiatric study of extramural populations was once initiated to provide material with which to compare the accumulating knowledge of eugenic prognosis in families tainted with psychiatric disorder. Eventually interest was focused on providing figures for the planning of facilities for the mentally ill. At the same time, however, demographic and social groupings became of interest. Certain authors looked upon some of these more or less as an effect of the disorders, while other researchers, more dynamically influenced, regarded the groupings more or less as their cause.

The author of the present volume is a professor of both psychiatry and sociology. While his psychiatric interest is thus naturally bent towards sociocultural problems, it remains perfectly open also to genetical and organic issues. So even though the actual study is expressly dedicated to investigating the sociocultural influence on disorders, the author repeatedly warns the reader not to forget that the reverse process is also possible.

The present volume with its 400 pages is in reality an overture, a sophisticated introduction to the population study itself. It is a systematic attempt to clarify step by step the various concepts, assumptions and conditions, in other words the philosophy, with which the investigation is concerned.

Thus the first part of the book, embracing some 100 pages, is a broad survey of psychiatric disorders and their nature. Starting from a couple of concrete life histories and personality reactions, as outlined in an easy literary style, the author endeavors to impress upon the reader what is meant by a psychiatric case and how heredity, life experience, bodily disease, and actual social relationships and happenings interact in its derivation. The reader becomes strongly aware of the complexity of the factors, and is prevented from taking the popular short cut of looking at cause and result as a simple one-way relationship. Despite its detail and its remarkable lack of professional terms, or rather by virtue of these features, I would like every medical student to read this part of the book and to ponder on it more than once. Why not make a separate little textbook of these chapters?

The following parts, dealing with the relations between psychiatric disorders and sociocultural elements, and with the sociocultural environment itself, develop into what is most essential to the author, a theory of sentiments. Sentiments are,

for instance, the conviction, belief, or attitude that one should do one's best, or that mental disease is dishonorable. Sentiments pertain at the same time to personality and to cultural environment. One can think of sentiments as being characteristic of cultures, as influencing individuals, and so on. Above all, the particular sentiments can be ascertained by means of anthropological and sociological exploration, while the particular sociocultural environment is not easily defined.

Thus the study of sentiments might be a convenient method for studying the impact of sociocultural factors on mental disorder, and the author is on the lookout for cultures with sentiments as contrasting as possible. What types of communities should be chosen for this purpose? The author proceeds to define what he calls a disintegrated society in contrast to an integrated or rather a self-integrating society. The first type would be a society which is not a community in the real sense of the word but merely a "collection" of people. There will certainly be a number of individuals living, but not living together, they will have no organized facilities in common, everybody earning his own living and conducting his life independently. Societies of this extreme type may not be found easily, but the approximate type could presumably be sought for in areas exposed to recent disaster or with widespread ill health and poverty, with cultural confusion, extensive migration, rapid and widespread social change and secularization. In such societies one is likely to find real signs of disintegration, such as a high frequency of broken homes, few and weak associations and leaders, high frequency of hostility, crime and delinquency, few patterns of recreation, a weak and fragmented network of communication. In fact, various specimens of disintegrated and well-integrated societies were found within the area investigated, and the ascertainment of psychiatric disorders was mainly attempted there. The principles of case-finding are described in a final chapter winding up this introduction to the future presentation of results.

It is not merely the matter itself which makes the reader's appetite grow in the course of his studying this first volume, the contents of which are here but superficially outlined; it is the scientific intricacy of the problem, so conscientiously and ingeniously exposed by the author. It is also the repeated assurance that the procedure to be adopted in the two forthcoming volumes will not be confined to the somewhat mechanical method en vogue at present, namely, that of accepting or rejecting a limited number of hypotheses formulated in advance. Instead the author holds out the more stimulating prospect of grouping and hunting and looking out for whatever might appear.

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EXCELLENCE: John Gardner. Harper and Brothers, New York, 1961, 171 pp. (including index pages), $3.95.

This book will be much commended and little criticised. It is ably written, brief, and refreshingly readable. But few will recognize it for what it is; one of the important books of a period in which we must rather quickly remake our world, or run the chance of seeing it go to pieces.

Unwilling to give up quality, we may not know how to embrace excellence, and lacking excellence we will give way

before those abler than ourselves. This is the problem presented in this book. It is thus an important book for all concerned with our country's future. For those who are concerned with the immediate problems of American education it is a "must."

Probably no one in this country is more qualified than is John Gardner to deal with the question of who should go to college, what they should be taught, how they should be selected; the weaknesses of intelligence tests and our necessary dependence on them; how they should be used and how supplemented. The headings of the two chapters which deal specifically with the American college should arrest the attention of every educator—"Education as a Sorting-Out Process," "The Rigors of Sorting Out," "The Hazards of Mediocrity." And the next, "College and the Alternatives," "Who Should go to College," "The Need for Institutional Diversity," "Opportunities Other than College." One wishes that every parent with children of high school age could read these chapters. A better understanding of individual differences would lead to so much more individual fulfillment, and avoid so much heartache.

Gardner believes that "a long continued process of 'sorting out' of the population (such as we have engaged in for some years and will probably intensify) will inevitably pull a substantial portion of the gifted to the top and leave the less gifted behind. Fortunately the sifting will never be completed. Thanks to assortative mating" (does he not in this context mean random mating?) "and the facts of genetics, both bright and dull children will continue to appear throughout society." But the sifting process will go a long way in the generation immediately ahead. Again to quote Gardner: "Barring drastic equalitarian countermoves designed to halt the search for talent, we shall move towards a society in which the most gifted and most capable people are at the top. This is what we always thought of as the ideal society. And it is the only kind of society that can hold its own in today's world."

"But," says Gardner, "how will it suit the people who are not on top? Will it be any more palatable to them to be underlings in a society ruled by high I.Q.'s than in a society ruled by high-born families? Or will it be even less palatable? To the extent that the less able individual does resent the sifting out of talent, to that extent he will foster the various institutional defences which are designed to ensure that high performance shall not be the chief criterion for status." (pg. 114-115.)

To solve this problem we must provide opportunities and rewards for individuals of all degrees of ability, so that individuals at every level will realize their full potentialities, perform at their best, and harbor no resentment towards any other level. The balance of the book is concerned with how this might be done. In a chapter on Talent and Leadership he discusses our system of leadership, widely dispersed and distributed, of many kinds and at many levels. In the next chapter he discusses the many kinds of excellence, and the equally numerous ways of judging excellence; fashions in excellence, and the toning up of the whole society. Then the level of individual fulfillment, and finally the aims of a free people. All this to the point of attaining excellence of so many kinds on so broad a front that it will lead to no feeling of envy, no sense of inferiority. There are many possibilities

and he presents them effectively. If the latter part of the book is exhortation, we hear it gladly. The solutions he suggests would make for our survival.

In considering solutions Gardner does not get himself involved in any problems of heredity vs. environment. He recognizes that both factors are inextricably intertwined in the processes of development. But it is implicit in much of what he says that genetic variations play a part in all the gradations of excellence with which he is concerned. The problem of the educator is to devise systems of education which will bring out the best possibilities of each genetic type. And it is the unwillingness of the public in a democracy to recognize genetic variations which poses the greatest problems to the educator.

Probably because of the public's present attitude towards genetic differences, Gardner deliberately omits any discussion of the possibility of raising the level of hereditary potential of the less able group. But if the stratification which Gardner foresees is allowed to become increasingly a genetic stratification, the condition he hopes to cure would become incurable. It would no longer be possible to reconcile with the American idea of equality.

FREDERICK OSBORN

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MEETINGS AND RECENT PUBLICATIONS

ACADEMY OF MEDICAL SCIENCES OF THE USSR —History and Organization: Galina V. Zarechnak. Public Health Monograph No. 63. U.S. Department of Health, Education, and Welfare, Public Health Service, 1960, 48 pp.

This monograph describes the greatest scientific medical institution of the USSR, the Academy of Medical Sciences.

Medical research in the Soviet Union is not only highly centralized but subject to strict governmental planning and control. Interestingly enough, radiation sickness is given top priority in medical research, then the persistent diseases such as influenza, rheumatic fever, malignant tumors, heart diseases, and diseases of the nervous system. More attention has been paid to physiology than any other branch of medicine. Pavlov remains the pillar of the materialistic viewpoint. The "reactionary tendencies" of the Western scientists are to be resisted who want "to revise Pavlov's theory about the higher nervous system, to replace it by the idealistic Freudian theories, or to reconcile the two." Dialectic materialism is still proclaimed as the basis of all scientific research, and scholars have to adapt themselves to variations in the "party line."

The development of medical publishing in the Academy of Medical Sciences has been very uneven. It reached its peak in 1950, then dropped to a low that lasted until 1956. The trend is now upward. Difficulties with the system of reviewing manuscripts and lagging printing schedules, however, have decreased the enthusiasm of Academy members for publication.

Scientists, artists, and writers, apart from Government officials, are the best-paid people in the USSR. A seven-year plan, from 1959-1965, provides for great expansion of the Academy both in publishing and research. Biology and genetics are marked for special interest. The author concludes that, as long as the desire to excel continues, the Academy of Medical Sciences will be given enough support for significant accomplishment.

The author of this monograph administers the acquisition of medical publications in Russian and other Slavic tongues in the U.S. National Library of Medicine. Compilation of this work in the United States has made it possible to use sources additional to those of the Soviet Union.

PROBLEMS IN AFRICAN DEMOGRAPHY—A Colloquium: Paris, 1959. Union Internationale pour L'Etude Scientifique de la Population, Paris, 1960, 60 pp., $1.00.

This report of an international demographic seminar on Africa is of particular significance both because of the present world-wide concern with Africa and because of the scarcity of demographic material about this continent.

This conference, under the sponsorship of the International Union for the Scientific Study of Population, considered objectives and methods in the development of demographic material in Africa. Frank Lorimer acted as organizer and Dudley Kirk as rapporteur. It is impossible to obtain demographic data on Africa in the detail that it is available in other, more highly literate areas, and well-controlled, essential studies on African marriage and fertility were considered necessary by the conference. Lorimer reported that remarkable progress had been made in the last twelve years in demographic statistics in Africa but that information on mortality, fertility, and migration is sadly deficient. The need for a new approach to dynamics of population in Africa was stressed, the next step being pilot studies in selected areas. Several forms of international cooperation were explored.

This report is useful to anyone wanting material on African demography or wishing to understand the problems of this continent.

SEMINAR ON EVALUATION AND UTILIZATION OF POPULATION CENSUS DATA IN ASIA AND THE FAR EAST: Bombay, 1960. United Nations, New York, 1961, 93 pp.

SEMINAR ON EVALUATION AND UTILIZATION OF POPULATION CENSUS DATA IN LATIN AMERICA: Santiago, 1959. United Nations, New York, 1960, 98 pp.

The United Nations' Bombay seminar was organized to aid governments in Asia and the Far East plan their census program in order to provide the most information relevant to practical problems of policy making and planning in social and economic development. The Santiago seminar was planned to help Latin American countries utilize the population censuses of 1960 in economic and social-development planning and policy making.

Both conferences suggested that additional data on factors affecting fertility could be obtained by fuller tabulations of census items and that sample surveys of fertility in relation to economic and social characteristics could provide more information than the census, i.e., desire for children, attitude toward family planning, etc. It was agreed that great progress had been made in demographic research and training in Latin America and Asia, but that much remained to be done, especially in the application of demography to social planning.

AGE PROFILE—U. S. A. (Prepared for the White House Conference on Aging): Population Reference Bureau, 1961, 15 pp.

This pamphlet, prepared for the White House Conference on Aging, is made up chiefly of explanatory charts portraying the age profile of the United States.

Contrary to the popular belief, the proportion of people over 65 has increased rather slowly, even though their absolute numbers have grown rapidly, according to Robert C. Cook, President of the Population Reference Bureau, in his Foreword. This curious situation can have profound social and political implications. We have a large percentage—40 per cent—of children and adolescents to make heavy demands on schooling, housing, and other essential amenities which provides competition for funds for services to senior citizens. Our population will grow both older and younger in the next 20 years, predicts Cook.

HUSBANDS AND WIVES—The Dynamics of Married Living: Robert O. Blood, Jr. and Donald M. Woolf. Free Press, Glencoe, Ill., 1960, 288 pp., $5.00.

This book is one of the first, according to the authors, to describe marriage relationships in a cross-section sample of an entire community—metropolitan Detroit— and to give comparative data from a sample of farm families.

The chapter, "Having Children," is of special interest to students of fertility. Not less than two children, not more than four, was the popular desire, and above three satisfaction declines rapidly. The farm families tend to desire more children than the city families. By and large Americans say they want fewer children because they love them so much, not because they like them so little, the authors find. But the record of actual achievement of childbearing goals is comparatively poor; nearly all the misses fell short of the mark rather than exceeding it. The 909 American wives in this study remarkably often report failure in their childbearing goals. American marriages have a long way to go to achieve anywhere near general success in reaching childbearing goals, according to these authors.

Compared with the prophecies of doom about marriage, most American marriages sparkle, the authors conclude. They find little evidence from this study that marriage in our country is on the verge of catastrophe.

MEETINGS

New York: The Medical and Scientific Committee of the Human Betterment Association of America, Inc., is sponsoring a Conference on "Surgical Birth Control—One Answer to Involuntary Parenthood" to be held Thursday evening, April 13, 1961, at 8:00 P.M. at the Carnegie Endowment International Center, New York City. Dr. Alan F. Guttmacher, Chairman of the sponsoring committee and Director of

Obstetrics and Gynecology at The Mount Sinai Hospital, will preside, and Dr. Ira DeA. Reid, Chairman of the Department of Sociology of Haverford College, will speak. Panelists include Mrs. Harriet F. Pilpel (Law), Dr. Mortimer W. Rodgers (Medicine), Dr. Robert W. Laidlaw (Psychiatry), the Reverend William Genné (Clergy), Doris Siegel (Social Work), and Dr. Sophia M. Robinson (Sociology).

Newark: The Academy of Medicine of New Jersey will present a "Symposium on Congenital Defects" on Wednesday afternoon and evening, April 19, 1961, at the Essex House, Newark, New Jersey. Co-sponsors of the symposium are The National Foundation, The Medical Society of New Jersey, and the New Jersey State Department of Health. Moderated by Dr. Daniel Bergsma of The National Foundation, the program will include papers by Drs. James D. Ebert, F. Clarke Fraser, Elizabeth M. Ramsey, Alexander Barry, William J. Young II, and James L. Wilson.

New York: The 69th Annual Convention of the American Psychological Association will take place August 31-September 6, 1961, at the Commodore, Biltmore, and Roosevelt Hotels, New York City.

Rome: A Quarterly Bulletin, 1961 *Rome Genetics Conference News*, reports news of the 2nd International Conference of Human Genetics, to be held in Rome, September 7-12, 1961. A joint session with the 7th International Congress of Neurology which meets in Rome at that time is being arranged. General sessions will be conducted both as lectures and round tables, with and without discussion. Simultaneous symposia will be held when it is unlikely that the subjects will overlap.

Pretoria: The 2nd Genetic Congress of South Africa will take place in July 1961 in Pretoria under the chairmanship of Professor J. D. J. Hofmeyr, head of the Department of Genetics, University of Pretoria, and President of the South African Genetic Society. The Society is working to establish a South African Anthropogenetic Institute which would organize studies in human heredity in South Africa.

FILMS

A new teaching film, *Medical Genetics, Part* 1, has been prepared by Victor A. McKusick, M.D., and his associates in the Department of Medical Genetics, Johns Hopkins University School of Medicine. It covers historical development, physical basis of inheritance, and some chromosomal abnormalities in man. The film may be obtained free of charge from The National Foundation (800 2nd Avenue, New York 17).

HELEN HAMMONS

Periodical Reviews

GENETICS

MORE CHROMOSOMAL ANOMALIES

The "double male": a new chromosome constitution in Klinefelter's syndrome. S. Muldal and C. H. Ockey. *Lancet,* 7148 (1960), pp. 492-493.

Nondisjunction at either the first or second meiotic division can result in reproductive cells with an abnormal chromosome number. Nondisjunction at both meiotic divisions can result in even more exceptional gametes. For example, if nondisjunction occurs at the first and/or the second meiotic division in a normal male, the following types of exceptional spermatozoa might occur for the sex chromosomes: No-X or Y, XY, XXY, XYY, XXYY, XX, and YY. Likewise, nondisjunction at the first and/or second meiotic division in a normal female might result in the following exceptional eggs: No-X, XX, XXX, and XXXX.

A new chromosome entity is described. A mentally retarded 15-year-old boy showing Klinefelter's syndrome was shown to have 48 chromosomes, with an XXYY sex complement. One explanation is that an XYY sperm united with a normal X-bearing egg. An XXYY type might also occur from mitotic nondisjunction in XY cells during an early cleavage division, with survival of the XXYY cells.

In man, male-determining genes are largely on the Y chromosome, but these genes are likely on the X chromosome and autosomes as well. Female-determining genes are likely on the X and autosomes. Due to the predominantly male-determining effect of the Y chromosome, XY, XXY, or even XXXY types are male in appearance; that is, the male-determining genes outweigh the female-determining genes. In the absence of a Y chromosome, the female-determining genes outweigh the male determiners, and a female results. The authors refer to an XXYY individual as a "double male." If the "balance theory" of sex determination is true for man, as for other organisms that have been studied, the term "double male" is perhaps not appropriate. Even though an XXYY individual contains a double dose of male determiners on the Y chromosome, he very likely does not contain a double dose of all male determiners. A more appropriate name would be simply XXYY male.

The XXX syndrome—frequency among mental defectives and fertility. J. H. Fraser, J. Campbell, R. C. MacGillivray, E. Boyd, and B. Lennox, *Lancet,* 7155 (1960), pp. 626-627.

An individual with the XXX syndrome was first described by Jacobs and colleagues in 1959 (*Lancet,* 7100, pp. 423-425). This individual exhibited underdeveloped breasts, small vagina, and infantile genitalia. No menstruation occurred after age 19. Chromatin bodies were present in 71% of her oral mucosal cells, and 14% of these cells contained two of these bodies. In normal XX females, less than 41% of the oral mucosal cells are chromatin positive and two bodies do not occur.

Using the chromatin body phenomenon as a criterion of detection, the above authors surveyed patients in a mental deficiency hospital for the purpose of determining the frequency of XXX types. From a total of 595 successful oral mucosal smears, four (or 0.07%) showed a high count of single and double chromatin bodies. The number of chromosomes in each was then shown to be 47, with three X chromosomes being present.

Because of primary amenorrhea in the first case described, the logical assumption might have been that all the other individuals with three X chromosomes would show a similar defect. The authors have demonstrated that this is not the case. Although information is not available for the oldest, the other three individuals demonstrated a normal or nearly normal menstrual history. One of the patients had given birth to a normal male child! Fertility in this individual and another XXX individual recently reported (Stewart et al., *Lancet*, 7140 (1960), pp. 21-23) indicates that sterility is not a common feature of the XXX syndrome.

Primary amentia and micro-orchidism associated with an XXXY sex chromosome constitution. M. A. Ferguson-Smith, A. W. Johnston, and S. D. Handmaker. *Lancet*, 7143 (1960), pp. 184-187.

Two males in a mental deficiency institution with Klinefelter's syndrome exhibited a high frequency of oral mucosal cells with single and double chromatin bodies. Since the rule appears to be that the maximum number of chromatin bodies that will be found is one less than the number of X chromosomes, this observation suggests the presence of three X chromosomes. In fact, a cytological examination revealed an XXXY sex chromosome complement in both of these individuals. Each has the characteristics of Klinefelter's syndrome. In addition, they are severely mentally deficient, and congenital malformations occur in one.

These two individuals are of interest in another respect. If the addition of a Y chromosome to an otherwise XX sex complement results in a male (Klinefelter's syndrome), would not the addition of an X chromosome to an XXY sex chromosome have a feminizing effect, if the X chromosomes contain important female determining genes? Since both are typical Klinefelters, does this suggest that the autosomes are the site of important female determiners?

Chromosomal trisomy associated with the Sturge-Weber syndrome. M. D. Hayward and B. D. Bower. *Lancet*, 7155 (1960), pp. 844-846.

The authors present a case they believe represents a trisomic condition of chromosome 22 in man. A three-year-old boy was studied showing gross mental retardation, small head circumference, and calcification in the right parieto-occipital region with gyral distribution typical of the Sturge-Weber syndrome.

A cytological analysis showed 47 chromosomes, with evidence that the extra chromosome is the nonsatellited, acrocentric autosome designated by the Denver system as number 22. Chromosome 22 is similar in size to the satellited chromosome number 21. When the genetic material in the latter chromosome is present in the three-fold condition, mongolian idiocy results.

It is of interest that a triplo-22 has now been described. However, more

cases are needed before it can be concluded definitely that this chromosome condition results in the Sturge-Weber syndrome. In fact, because chromosome 22 is very similar morphologically to the Y chromosome, it is not absolutely certain that the young boy in question does not possess two Y chromosomes.

A child with 49 chromosomes. M. Fraccaro, K. Kaiiser, and J. Lindsten. *Lancet*, **7156** (1960), pp. 899-902.

In any new field, each investigation is apt to bring forth surprises. This is certainly true for human cytogenetics. Although it might be predicted that trisomy for one of the large autosomes could result in multiple gross malformations incompatible with life, evidence now coming out shows that perhaps this is not always the case. The present authors describe a young boy, age seven, with 49 chromosomes. A cytological analysis revealed trisomy for chromosomes 8 and 11, in addition to an XXY sex chromosome complement. The boy had malformed genitalia, congenital heart disease, kidney malformation, and was mentally retarded. A single abnormal testis was found in the right groin. With the double trisomic condition involving the autosomes, it is remarkable that the child has lived to age seven and is not more seriously malformed. This suggests that perhaps the degree of the manifestation expressed by an unbalanced chromosome set in man is influenced by the genetic background.

Gonadal dysgenesis (Turner's Syndrome) with male phenotype and XO chromosomal constitution. W. Bloise, C. Bottura, L. M. deAssis, and I. Ferrari. *Lancet*, **7159** (1960), pp. 1059-1960.

As further evidence that the phenotypic manifestation of an abnormal chromosome number cannot always be predicted, the authors describe a case of an XO individual with a male phenotype. Up until this time, all XO types have been described as females. These females have demonstrated gonadal dysgenesis or agenesis and lack of secondary sex characteristics, often associated with reduced mentality and multiple congenital anomalies. Consequently, the occurrence of a male with an XO condition is unexpected.

The male in question was eight when examined. He was shown to have embryonic testes and a rudimentary uterus. The chromosome number was given as 45.

True hermaphroditism with XY/XO mosaicism. K. Hirschhorn, W. H. Decker, and H. L. Cooper. *Lancet*, **7145** (1960), pp. 319-320.

A three-month-old child was studied who exhibited a phallus, vagina, and hypospadias. Laparotomy revealed a uterus, oviducts, and two gonads in the position of ovaries. Both testicular and ovarian structures were found in one of the gonads, indicating that the child is a true hermaphrodite.

A cytological examination revealed two different types of bone marrow cells. Sixty per cent were XY and 40 per cent XO. It is likely that following the production of an XY zygote, a Y chromosome was lost in a cell during one of the early cleavage divisions, giving this cell and its descendants 45 chromosomes with a single X chromosome. The combination of both types of cells in the same gonad might cause both testicular and ovarian tissue to form.

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POPULATION

Hypergamy, Hypergenation, and Miscegenation. Pierre L. van den Berghe. *Human Relations* **13**, 1 (February 1960), 83-91.

An extensive literature has appeared on the subject of "assortative mating." Numerous studies suggest that, at least in the United States, marriage mates tend to resemble one another in general intelligence, cultural background, biological traits, and even prenuptial residence. There are reasons for believing that this is true in many other societies as well.

On the other hand, it has been noted that when two different populations occupy the same territory, an exchange of genes invariably occurs, with or without benefit of matrimony. Usually it is the males of the "superior" or dominant population and the females of the "inferior" or subordinate population who are involved. Such unions may range from formal marriage through more or less socially sanctioned concubinage to casual liaisons. Van den Berghe's paper is concerned with unions of a relatively lasting character involving individuals of differing status backgrounds. Under this heading fall both marriage and concubinage.

The author's central concept is *status maximization*. Marital and nonmarital unions will tend to cross status lines when they produce a gain in status for the woman and her children with no commensurate loss of status by the male partner. For such unions the author coins (alas!) the more inclusive term *hypergenation*. If sex ratios in the different status levels are close to unity, "hypergenation" will create a surplus of women at the top of the social hierarchy and a deficit at the bottom. The surplus at the top must be accompanied by either polygyny, monogamy combined with concubinage, or a high rate of spinsterhood. The deficit at the bottom can be reduced by a higher mean age at entry into unions for men than for women.

The following instances of "hypergenation" are briefly examined: Indian caste system marriages, Chinese concubinage, Western European marriages and extramarital unions, Japanese marriages involving adoption of a lower status male by the wife's parents, and U. S. interclass marriages. Van den Berghe's interpretation of the U. S. case is that when "hypergenous" unions occur, the male's higher status is exchanged for the female's physical attractiveness—scarcely a startling conclusion!

Nonmarital unions across racial lines are said to be common when concubinage is "institutionalized" so that the male does not lose status. A more competitive type of race relations is said to destroy such institutionalization. Finally, interracial *marriages*, which in the U. S. characteristically involve white females and Negro males, are interpreted —following Merton—as involving an exchange of the female's higher *caste* status for the male's higher *class* status. (The female white partners tend to be of lower class and immigrant stock, while the male Negro partners tend to be of upper and middle class status.)

Van den Berghe's analysis could be greatly enriched by a quantitative approach. Even without reliable empirical data it should be possible to estimate the quantitative effect of "hypergena-

tion" in producing deficits of females at lower levels, using various assumptions about (1) male and female survivorship and (2) mean ages at entry into marital and nonmarital unions. The extent to which polygyny in stratified societies "must" involve "hypergenation" is subject to quantitative determination.

It is also quite possible that some "hypergenous" unions constitute a means of disposing of unwanted female offspring, and thus provide a structural alternative to female infanticide. On this interpretation, females in many societies may be a surplus commodity for those living at a marginal level of subsistence, with "hypergenation" and upper level polygyny a consequence. This seems to be the case in some agrarian societies, including Van den Berghe's traditional Chinese case. This view is quite compatible with the balance of the author's argument.

So far as interracial unions are concerned, Van den Berghe does not seem to add much to our knowledge. To say that a more competitive type of race relations destroys the institutionalization of interracial concubinage tells us little unless the mechanism is specified. One may be permitted to doubt that this mechanism has much to do with "status maximization," except in a trivial sense when such unions become unpopular.

In conclusion, Van den Berghe seems to this reviewer to provide considerable food for thought on a most interesting topic. He is to be commended for recognizing the value of analyzing both marital and nonmarital unions across class and color lines within a single framework. It is not so clear that he has worked out all of the factual and logical implications of his analysis.

The Cocos-Keeling Islands: A Demographic Laboratory. T. E. Smith. *Population Studies* 14, 2 (November 1960), 94-130.

The Cocos Islands are a remote atoll in the Indian Ocean where the author served as Administrator during 1946-47. He has been able to obtain copies of records relating to births, deaths, and marriages which are so complete as to approximate a continuous population register for the period 1888 through 1947.

During the latter part of this period (1921-1947), the annual increase of the Malay population averaged over 3.2 per cent, an impressive growth rate indeed. Partly due to the benefits of the paternalistic regime of the Clunies-Ross family, the crude death rate after the First World War never seems to have risen much above 20 per 1,000, while the crude birth rate ranged in the neighborhood of 50 to 60 per 1,000 throughout the entire period. Women living through the childbearing period averaged 8 to 9 births, a figure which approaches—but does not equal—the Hutterite community of North America.

An intriguing finding is that Cocos Malay women married at age 16 had experienced an average of 9½ live births by age 40, while those married at 20 or 21 had an average of only 6¼ births by age 40. In other words, postponement of marriage for 4 or 5 years beyond age 16 is associated with a reduction in fertility, completed by age 40, averaging over 3 live births, or about 33 per cent. This observation is made in a society in which the great majority of women marry before age 20, and in which over two-thirds of the women were pregnant at the time of marriage. Although Smith

does not note the connection, it seems plausible to assume that the later-marrying women are selected for lower fecundity. Thus the implications of his conclusion that "for the Cocos population (and possibly for many other high-fertility populations) postponement of marriage and of commencement of childbearing beyond the age of 16 tends to reduce total fertility" are far from unambiguous.

Another interesting finding is a gradual increase in the length of average intervals between pregnancies associated with an increase in the survivorship of infants. This "suggests a positive correlation between birth interval and length of period of lactation."

T. E. Smith's paper is so rich in data, and involves such generally careful analysis, that a full summary cannot be given in this place. The two findings cited above have relevance respectively for recent discussions of (1) the possible importance of a fall in the age at marriage in early transitional Western Europe, and (2) lactation as an inhibitor of fecundity. The reader is referred to the original article for many other interesting and suggestive findings.

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